Systems and Infrastructure Lifecycle Management

Introduction

- Unit 1 -
Agenda

• Introduction
• IT Auditor’s role in System and Infrastructure lifecycle
• Project and Visio
• IT Auditor’s responsibilities and roles
• Information system development – a brief history
• Type of business information systems
• Quiz
Introduction

Introduce yourself **briefly** to your instructor and the class

- Education
- Work history
- Experience with Information Systems Development
- Goal for the class
Introduction

This course will introduce you to the methods used as organizations builds an enterprise information system architecture within an environment of internal control

Topics include:

• Information system planning, development, acquisition and maintenance of these technologies and their impact on the organization’s business processes
Introduction

Course objective - help you understand what it means to:

• Evaluate the business case for the proposed investments in information systems
• Evaluate the project management framework and controls to determine whether business requirements are achieved in a cost-effective manner while managing risks to the organization
• Conduct reviews to determine whether a project is progressing in accordance with project plans, is adequately supported by documentation, and has timely and accurate status reporting
• Evaluate controls for information systems during the requirements, acquisition, development and testing standards, procedures and applicable external requirements
• Evaluate the readiness of information systems for implementation and migration into production to determine whether project deliverables, controls and the requirements are met
• Conduct post-implementation reviews of systems to determine whether project deliverables, controls and the requirements are met
Introduction

MIS 5203.401 - Systems and Infrastructure Life Cycle Management

Systems and Infrastructure Lifecycle Management
January 14, 2019 & David Leiser

This course will introduce you to the methods used as organizations build an enterprise information system architecture within an environment of internal control. Topics include information system planning, management and usage, the development, acquisition and maintenance of these technologies and their impact on the organization's business processes.

Course Objectives

1. Evaluate the business case for the proposed investments in information systems acquisition, development, maintenance and subsequent retirement to determine whether it meets business objectives.
2. Evaluate IT supplier selection and contract management processes to ensure service levels and requisite controls are met.
3. Evaluate the project management framework and controls to determine whether business requirements are achieved in a cost-effective manner while managing risks to the organization.
4. Conduct reviews to determine whether a project is progressing in accordance with project plans, is adequately supported by documentation, and has timely and accurate status reporting.
5. Evaluate controls for information systems during the requirements, acquisition, development and testing stages, procedures and applicable security requirements.
6. Evaluate the readiness of information systems for implementation and migration into production to determine whether project deliverables, controls and the requirements are met.
7. Conduct post-implementation reviews of systems to determine whether project deliverables, controls and the requirements are met.
Introduction - Syllabus
## Introduction - Schedule

<table>
<thead>
<tr>
<th>Unit #</th>
<th>Topics</th>
<th>Date</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>1/15</td>
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<tr>
<td>2</td>
<td>Information System Development Life Cycle (SDLC)</td>
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<td>3</td>
<td>Case Study 1 – “Teradata Data Mart Consolidation Return on Investment at GST”</td>
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<td>Project Initiation and Selection</td>
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<td>4</td>
<td>Project Planning and Management</td>
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<tr>
<td>5</td>
<td>Requirements Analysis – Processes</td>
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<td>8</td>
<td>Case Study 2 – “Mudra Communications”</td>
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<td>Design - Database</td>
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<td>9</td>
<td>Design – User Experience</td>
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<td>10</td>
<td>Development</td>
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<td>11</td>
<td>Implementation and Testing</td>
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<td>Post-Implementation</td>
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<td>14</td>
<td><strong>Review</strong></td>
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Introduction - Readings
# Introduction - Readings

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<td></td>
<td>Halakang, A. LJK (2012) <em>Project Portfolio Management</em></td>
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<td>Ravul, V. and Sharma, R. (2017) <em>Mitigating the Risk Factors of IT Project Failure</em></td>
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<td>Singleton, T. (2014) <em>The Logical Reason for Consideration of IT</em></td>
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<td>Singleton, T. (2014) <em>The Core of IT Auditing</em></td>
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<td>Singleton, T. (2011) <em>Understanding the New SOC Reports</em></td>
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<td>Singleton, T. (2010) <em>IT Audits of Cloud and SaaS</em></td>
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<td>FedRAMP</td>
<td>“CSP Authorization Playbook – Getting Started with FedRAMP”</td>
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<td>FIPS</td>
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<td>Special Publication 800-34 Revision 1 “Contingency Planning Guide for Federal Information Systems”</td>
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## Introduction - Weekly cycle

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<td>Saturday 11:59 AM</td>
<td>Student</td>
<td>Post answers to reading questions</td>
<td>Assignment</td>
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<tr>
<td>Monday 11:59 AM</td>
<td>Student</td>
<td>Post 3 comments to others’ answers</td>
<td>Participation</td>
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<tr>
<td>Tuesday</td>
<td>Both of Us</td>
<td>Class meeting</td>
<td>Participation</td>
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<td>Wednesday</td>
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<td>Post Wrap-up notes</td>
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Introduction - Weekly Questions and Comments

MIS 5203.401 - Systems and Infrastructure Life Cycle Management

Unit 02: IS Development Lifecycle (ISDLC)

All Questions
January 12, 2019 by David Lamon (Edit)

1. Why do information system (IS) development projects fail?
2. What should organizations do to control risks of IS project failures?
3. How does strategy affect which information systems a company chooses to develop and use?

Question 1
January 12, 2019 by David Lamon — Leave a Comment (Edit)

Why do information system (IS) development projects fail?

Question 2
January 12, 2019 by David Lamon — Leave a Comment (Edit)

What should organizations do to control risks of IS project failures?

Question 3
January 12, 2019 by David Lamon — Leave a Comment (Edit)

How does strategy affect which information systems a company chooses to develop and use?
IT Auditors’ responsibilities

• Providing assurance that enterprise objectives are being met by information systems and infrastructure management practices

• Identifying which elements may represent greatest risk, and which controls are most effective at mitigating this risk
IT Auditors are responsible for:

- Understanding which methodologies are in use for:
  - Systems development, acquisition and maintenance
  - Identifying potential vulnerabilities and points requiring control
- Advising project team and senior management of deficiencies and best practices within each of these processes

NIST SP 800-64r2 Security Considerations in the System Development Life Cycle
IT Auditor’s Role in Information System Development

Two alternative approaches

1. Review end-stage deliverables throughout the development process, without becoming part of the process
   • Auditor reviews each stage’s deliverables to ensure:
     i. What was planned from the previous stage has been accomplished and the planning of the next stage has been refined appropriately
     ii. Planning of the next stage has been refined appropriately

2. Internal control consultant, becoming part of the systems development process
   • Auditor provides ongoing proactive recommendations by participating in selected project-management meetings including: risk-assessment, systems-design, development, and systems delivery meetings
   • Auditor’s independence may be compromised, but this is mitigated by another auditor who should find a system with well-designed controls incorporated
IT Auditor’s Role in Information System Development

Produce and provide formal audit reports to the appropriate business managers including:

1. Overall assessment of the controlled progress of the project
2. Areas requiring improvement to complete the project, as specified, within budget and at an appropriate level of quality

Requires an in-depth understanding of both:

1. The overall information systems development processes adopted
2. The business processes being computerized
Acquire and install tools

- Microsoft Project
- Microsoft Visio
Information Systems Development – a brief history

• **Prior 1946** - Before “stored-program” digital computers
  • Devices were pure hardware and had no software - their computing powers were directly tied to their specific form and engineering

• Computing as a concept goes back to ancient times
  • Beginning with devices such as the **abacus**
    • Calculating tool used in China, Europe, and Russia centuries before adoption of written Hindu-Arabic numeral system we use today
  • Continuing on through early examples of computing such as the **Antikythera** mechanism
    • Ancient Greek analog computer used as a calendar to predict eclipses and astronomical positions decades in advance

*Wikipedia – History of Software*
Information Systems Development – a brief history

- **Prior 1946** - Before “stored-program” digital computers
  - **1837 – The Analytical Engine**
    - First design for a general-purpose computer
    - Designed by English mathematician Charles Babbage
    - Incorporated:
      - Integrated memory
      - Arithmetic logic unit
      - Control flow in the form of conditional branching and loops
    - Logical structure essentially the same as the computer design that dominates in today’s electronic era
  - First known computer program was written by Ada Lovelace to implement Luigi Menabrea’s equations for generating a Bernoulli number sequence of rational numbers
    - The Analytical Engine predated the techniques of electrical engineering needed to run it

*Wikipedia – History of Software*
Prior 1946 - Before “stored-program” digital computers

- **1935** – Alan Turing proposed the first modern theory of **software**
  - Software requires
    - A **general-purpose processor** - described as a Turing machine
    - **Computer memory**
      - In which reusable sets of routines and mathematical functions comprising programs can be stored, started, and stopped individually

- This concept is recent in human history, led to the creation of the twin academic fields of **computer science** and **software engineering**
Information Systems Development – a brief history

• **1948 – 1979** Early days of computer software
  
  • 1948 - Claud Shannon “Father of Information Theory” wrote *A Mathematical theory of Communication* and provided an outline for how **binary logic** could be *implemented to program a computer*
    
    • Subsequently, the first computer programmers used binary code to instruct computers to perform various tasks

  • **1948 – Birth of Software** Tim Kilburn at the University of Manchester UK wrote the first program code stored in an electronic memory to calculate the highest factor of an integer

  • **1950’s – 1960’s** **Development of high-level computer languages** Fortran, LISP, COBOL and BASIC allowed programs to be specified in an abstract way, independent of the precise details of the hardware architecture of the computer

  Wikipedia – History of Software

Margaret Hamilton led development of the onboard flight software for NASA’s Apollo spacecraft coined the term “software engineering”
1948 – 1979 Early days of computer software

- 1960’s – Massachusetts Institute of Technology, AT&T Bell Labs, and General Electric jointly developed an experimental *time sharing operating system* called Multics
  - Allowing multiple users to access a *mainframe computer* simultaneously
- 1970’s – Bell Lab’s researchers left the team and implemented a *self-hosting operating system* that became *UNIX* on a *minicomputer*
  - Included concepts of computer processes, device files, hierarchical file system, command-line interpreter, editor, programming shell, and assembler
  - Text editor and first text formatting and publishing program written in assembly language
  - 1973 – Unix Version 3 rewritten in higher-level C language
  - Most popular variant of Unix today is macOS Mac OS X
  - Linux is closely related

Wikipedia – History of Software
Information Systems Development – a brief history

• **1975 - Early days of computer software**
  • 1975 – Micro Instrumentation and Telemetry Systems begins selling Altair 8800 microcomputer kit by mail order
    • Microsoft released its first product Altair BASIC Operating system
  • Before microcomputers – a successful software program sold for $50,000 - $60,000 each in units of 1,000 units; PC software sold thousands of copies for $50 - $700 each

Wikipedia – History of Software
Information systems Development – a brief history

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<th>Era</th>
<th>Hardware</th>
<th>Operating System</th>
<th>Applications</th>
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<td>Mainframe (1970s)</td>
<td>Terminals connected to mainframe computer.</td>
<td>Time-sharing (TSO) on MVS</td>
<td>Custom-written MRP software</td>
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<tr>
<td>PC (mid-1980s)</td>
<td>IBM PC or compatible. Sometimes connected to mainframe computer via expansion card.</td>
<td>MS-DOS</td>
<td>WordPerfect, Lotus 1-2-3</td>
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<tr>
<td>Client-Server (late 80s to early 90s)</td>
<td>IBM PC “clone” on a Novell Network.</td>
<td>Windows for Workgroups</td>
<td>Microsoft Word, Microsoft Excel</td>
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<tr>
<td>World Wide Web (mid-90s to early 2000s)</td>
<td>IBM PC “clone” connected to company intranet.</td>
<td>Windows XP</td>
<td>Microsoft Office, Internet Explorer</td>
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<td>Web 2.0 (mid-2000s to present)</td>
<td>Laptop connected to company Wi-Fi.</td>
<td>Windows 7</td>
<td>Microsoft Office, Firefox</td>
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<tr>
<td>Post-PC (today and beyond)</td>
<td>Apple iPad</td>
<td>iOS</td>
<td>Mobile-friendly websites, mobile apps</td>
</tr>
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Manufacturing Resource Planning (ERP)
Enterprise Resource Planning (ERP)

https://bus206.pressbooks.com/chapter/chapter-1/
Information Systems Development – a brief history

- First-generation computer programming Languages “1GLs” (1948 – 1950’s)

- Second-generation “2GLs” (1950’s - today)

- Third-generation “3GLs” (1950’s – today)

- Fourth-generation “4GLs” (1970’s – today)

- Fifth-generation “5GLs” (1980’s – today)

Citation: https://www.revolvy.com
Information Systems Development – a brief history

• **First-generation “1GLs” (1948 – 1950’s)**
  • Binary machine languages entered through front panel switches

• **Second-generation “2GLs” (1950’s - today)** - Machine-dependent assembly languages
  • Code read and written by a programmer, to run on a computer it must be converted into a machine readable form, a process called assembly
  • Assembly language is specific to a particular processor family and environment (today usually found in device drivers)
  • Considered “low-level” because they are designed for and executed by physical hardware without further translation required.

• **Third-generation “3GLs” (1950’s – today)** - High-level programming languages, such as FORTRAN, LISP, COBOL, BASIC, Pascal, C, C++, C#, Java, and Javascript
  • Machine independent, more programmer-friendly, considered “high-level” because they are closer to human languages and further from machine languages, and hence require compilation or interpretation
  • Must be translated into machine language by a compiler or directly into behavior by an interpreter or compiler
  • Support structured programming, some support object-oriented programming

Citation: https://www.revolvy.com
Information Systems Development – a brief history

- **Fourth-generation “4GLs” (1970’s – today)** - Add additional features within general purpose 3GL environments, attempt to get closer to human language and require less coding than lower-level languages, such as Python, Ruby and Perl
  - Command-line languages that may includes support for general processing (e.g. UNIX Shell, Visual DataFlex, PowerBuilder, Cognos PowerHouse 4GL, DataFlex, IBM Rational EGL, Oracle Application, Development Framework,...)
  - Database management (e.g. SQL, FOCUS, OPenROAD, NATURAL, Informix-4GL,..)
  - Report generation (e.g. RPG-II, Oracle Reports, Progress 4GL)
  - Data manipulation and mathematical analysis (e.g. SAS, SPSS, R, S, PL/SQL, Stata, MATLAB, MathProg,...)
  - Graphical User Interface (GUI) development (XUL, Visual DataFlex, Progress 4GL, OPenRoad, 4th Dimension,...)
  - Web development (e.g. ActiveVFP, CFML, Wavemaker, OutSystems...)

- **Fifth-generation “5GLs” (1980’s – today)** - Solve problems by providing constraints to a general inferencing program without a programmer writing additional code or developing additional algorithms
  - Mainly used in artificial intelligence languages built on LISP (e.g. OPS5, SNEPS, Mercury...)
  - In 1980s, fifth-generation languages considered “way of the future”. Some predicted they would replace all other languages for system development, with exception of low-level languages
  - 1982 to 1993, Japan invested heavily in 5th generation computer systems project, hoping to design a massive computer network of general inferencing machines
  - Development of larger programs revealed flaws of the approach
    - Given a set of constraints defining a particular problem, deriving an efficient algorithm to solve it is a very difficult problem
    - This crucial step cannot yet be automated and still requires the insight of a human developer

Citation: https://www.revolvy.com
Most information systems today are developed with a combination of 3GL and 4GL capabilities

**Third-generation “3GLs” (1950’s – today)**
- High-level programming languages, such as FORTRAN, LISP, COBOL, BASIC, Pascal, C, C++, C#, Java, and Javascript

**Fourth-generation “4GLs” (1970’s – today)**
- Add additional features within general purpose 3GL environments, attempt to get closer to human language and require less coding than lower-level languages, such as Python, Ruby and Perl
Types of Business Information Systems

What types of information systems are used in businesses today?
What types of information systems are used in businesses today?
Some categories of Business Information Systems

Sales and marketing information systems

Help the firm with marketing business processes
• identifying customers for the firm's products or services
• developing products and services to meet their needs
• promoting products and services
and sales processes
• selling the products and services
• taking orders contacting customers
• providing customer support
Some categories of Business Information Systems

Manufacturing and production information systems

Deal with
• planning
• development
• production
of products and services

and controlling the flow
of production

Inventory master file

Data elements in inventory master file:
- Item code
- Description
- Units on hand
- Units on order
- Reorder point

Inventory Control System

Shipment and order data

Management reports

Online queries

Inventory Status Report
Report Date: 1/14/2007

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<th>Item Code</th>
<th>Description</th>
<th>Units on Hand</th>
<th>Units on Order</th>
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<td>Fan belt</td>
<td>10,211</td>
<td>0</td>
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<tr>
<td>4466</td>
<td>Power cord</td>
<td>55,710</td>
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<td>9313</td>
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<td>8808</td>
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<td>11,242</td>
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Some categories of Business Information Systems

Finance and accounting information systems

Keep track of the firm's financial assets and fund flows
Some categories of Business Information Systems

**Human resources information systems**

Maintain employee records, tracking
- employee skills
- job performance
- Training

Support planning for
- employee compensation
- career development

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Some categories of Business Information Systems

1. **Transaction processing systems (TPS)**
   Basic business systems serving operations by recording daily routine transactions for conducting business, such as payroll and sales receipts.

2. **Management information systems (MIS)**
   Provide current and historical performance information aiding planning, controlling, and decision making.

Some categories of Business Information Systems

3. **Decision support systems (DSS)** a.k.a. business intelligence systems
   - Support non-routine decisions not easily specified in advance
   - Use a variety of analytic models applied to large amounts of internal and external data

4. **Executive support systems (ESS)**
   - For non-routine strategic decisions requiring judgment, evaluation, and insight
   - Visual presentations of data within an interactive interface easy for senior managers to use
   - Information often delivered via a web portal as integrated information
Components of Information Systems

- **Hardware**: these are the devices like the monitor, processor, printer and keyboard, all of which work together to accept, process, show data and information.

- **Networks**: are a connecting system that allows diverse computers to distribute resources.

- **Software**: are the programs that allow the hardware to process the data.
  - **Databases**: are the gathering of associated files or tables containing related data.
  - **Procedures**: are the commands to the software and databases (for combining the components above to process information and produce the preferred output).
Software development lifecycle (SDLC) models are formal management processes for guiding the development of information systems. These include:

- **Waterfall Models**
  - Waterfall
  - Structured Systems Analysis and Design Method (SSADM)
- **Spiral and Iterative Models**
  - Structured Rapid Prototyping
  - Rapid Application development (RAD)
  - Agile Models
  - Rational Unified Model

If execution of the SDLC methodology is inadequate, however, the project may fail to meet business and user needs.

- **IS Auditor is responsible for verifying that the SDLC model is appropriate for the project’s goals and is properly implemented**
Quiz

Normally, it would be essential to involve which of the following stakeholders in the initiation stage of a project?

a) System owners
b) System users
c) System designers
d) System builders

An IS auditor has been asked to participate in project initiation meetings for a critical project. The IS auditor's MAIN concern should be that the:

a) complexity and risk associated with the project have been analyzed.
b) resources needed throughout the project have been determined.
c) technical deliverables have been identified.
d) a contract for external parties involved in the project has been completed.